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FLAG SMUT AND TAKE-ALL

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Flag smut of wheat was reported in the United States for the first time in 1919. During that year it was found in a considerable number of fields in the vicinity of Granite City, Madison county, Illinois. During the present season an extensive survey of the wheat fields in the vicinity of Granite City has been made, and flag smut has been found in 111 fields, comprising 2,500 acres, confined to an area of about 47 square miles. So far, flag smut has not been found outside of this area.

In several fields only a small amount of flag smut was present. In a few cases, however, as many as 20 to 25 stalks in one hundred were infected. It is evident that this disease is likely to cause very serious annual loss to the wheat growers of this country if it becomes widely distributed.

Flag smut has long been known in the wheat-growing sections of Australia, where annually it causes considerable damage. Commonly the loss caused is not very great, though frequently it amounts to 10 to 25 percent of the wheat crop. The disease is also known in Japan and India, and records of its occurrence in southern Europe have been found.

Another very serious disease of wheat, the so-called "take-all," has also been found in Illinois in the same general region as the flag smut, and was also reported in Mason and Sangamon counties in 1919. This year, however, take-all has not been so common nor so severe as last year, being found only in Madison county and in three fields in Mason county.

This brief circular is devoted mainly to a discussion of the appearance and control of flag smut, although some recommendations concerning take-all are given at the end.

FLAG SMUT

Appearance.—Flag smut of wheat appears mainly in the leaves of the plant. It shows as black lines, or streaks, running lengthwise in the leaf blades and sheaths. To some extent the stems are also in-

infected. These black lines are due to the formation of spores by the smut fungus. Most of the leaves on a stalk are infected, those at the upper part of the plant being injured most severely. Infected stalks are usually dwarfed, not growing to more than one-half to two-thirds of the height of healthy stalks, and they rarely head out or produce seed. Commonly all the stalks on a plant are infected, but occasionally a plant may produce both smutted and sound stalks.

Distribution.—Flag smut is distributed in two ways. One method is by means of smut spores that cling to the seed. In threshing, the spores are knocked out of diseased leaves and scattered over the grain. When the grain is planted and germinates, the adhering smut spores also germinate and the smut fungus penetrates the young seedling. A few weeks later a new crop of spores is produced on the leaves.

The other method of distribution is by means of spores in the soil. These come from infected stubble and from fragments of plants that fall to the ground in cutting the grain. They also are blown out of the separator on to the field when a smutted crop is threshed. These spores in the soil come in contact with the young wheat seedling and produce infection in the same way as those clinging to the seed. It is not known as yet how long the spores may live over in the soil but it is not probable that they persist over the winter.

Control.—The steps to be taken by the United States Department of Agriculture and the Illinois State Department of Agriculture are intended both to prevent the spread of flag smut beyond the quarantined area and to eradicate it from the infested region. The measures agreed upon to accomplish these two purposes are:

1. The thorough treatment of all grain with formaldehyde as it comes from the separator, 1 pound of formaldehyde in 3 pints of water being used for 25 bushels of grain.
2. The burning of all straw in the quarantined area as soon as possible after threshing.
3. Sowing no wheat on infested fields, and so far as possible sowing no wheat on land which grew wheat this year.
4. The obtaining of seed from localities known to be free from flag smut.
5. The treatment of all seed sown, by the copper-sulfate or bluestone method. This consists in dipping the grain for ten minutes in a solution of bluestone (1 pound of the stone to 5 gallons of water) and then dipping in a solution of lime (1 pound to 10 gallons of water). The great advantage of this treatment is that the seed remains coated with the bluestone and lime, and this coating protects it to a large extent from infection by spores present in the soil.
6. The growing of varieties that, so far as known, are highly resistant to flag smut.

Varieties of Wheat Resistant to Flag Smut.—The United States Department of Agriculture and the University of Illinois have carried on some experiments during the past year along this line and have secured some promising results. The resistance or susceptibility of a large number of wheat varieties to flag smut has been tested.

It has been found that certain varieties of wheat are distinctly resistant to the attack of this disease. There is, however, no good yielding wheat known that is entirely immune to it, but the difference between some of the very susceptible and the slightly susceptible varieties is marked and certainly worth considering in selecting seed wheats. Still, not all resistant wheats are good producers in the locality where flag smut has appeared; but in **Fulcaster, Gypsy, Red Wave, Turkey Red, and Red May** we have a combination of disease resistance and good yielding ability. These wheats are strongly recommended to be used in the flag smut area of Madison county.

Altho Red Wave appears in the list of desirable varieties because of its ability to yield and its tendency toward disease resistance, it must be remembered that it has the reputation of being very poor in milling and baking quality.

Certain other varieties, even tho their adaptability to conditions in the American Bottom is beyond question, should not be grown under any consideration because of susceptibility to disease. The most outstanding among these are Red Cross, so-called Salzer's Prize Taker, Salzer Pride, Dawson's Golden Chaff, Fultz, Illini Chief, and Jones' Winter Fife. A great many other varieties have been grown in the flag-smut plots, but because of not being well adapted to the locality or because of disease susceptibility they are not mentioned here.

The Illinois State Department of Agriculture, the United States Department of Agriculture, and the University of Illinois are aiding the farmers in every way possible to eradicate this serious enemy of the wheat crop. Expert assistance and formaldehyde are furnished



FIG. 1.—PORTIONS OF INFECTED WHEAT PLANTS, SHOWING FLAG-SMUT STREAKS ON THE BLADES (From Farmers' Bulletin 1063)

VARIETIES OF WHEAT RECOMMENDED FROM THE STANDPOINT OF YIELDS
AND OF DISEASE RESISTANCE*

Variety	Percentage rating in yield, using Fulcaster as standard		Percentage disease infection		Color of kernel	Hard or soft	Bearded or smooth
	At Alhambra	At Fairfield	Flag smut	Take-all			
FULCASTER...	100.0	100.0	Trace	2	Red	Semi-hard	Bearded
GYPSY.....	106.4	100.7	Trace	Not grown in Take-all plots	Red	Soft	Bearded
RED MAY. . .	Not in variety trials	Not in variety trials	Trace	0	Red	Soft	Smooth
RED WAVE. .	96.8	77	Trace	0	Red	Soft	Smooth
TURKEY RED	112.8	85	Trace	0	Red	Hard	Bearded

*In calculating the percentage yield at both Alhambra and Fairfield, Fulcaster has been used as the standard. The Turkey Red used at Alhambra and Fairfield was the improved strain, Turkey Red 10-110. The yield data at Alhambra cover the one year 1919, and the results on flag smut and take-all resistance at Granite City were obtained in experiments conducted in 1920. The wheat at Fairfield has been grown for a longer period; Fulcaster for 13 years (1907-1919); Gypsy for five years (1915-1919); Red Wave for four years (1915, 1917-1919); and Turkey Red 10-110 for two years (1918, 1919).

for treating the threshed grain. It is also planned to furnish blue-stone and lime, and expert assistance to every farmer in the treatment of the grain for fall sowing.

TAKE-ALL

Experiments with take-all made by the United States Department of Agriculture and the University of Illinois during the past year indicate that the disease may be very largely controlled by the use of resistant varieties. In variety trials on infested soil near Granite City, Illinois, 90 percent of the plants of the so-called Salzer's Prize Taker were affected with take-all. Red Cross and Illini Chief were somewhat less severely attacked, but showed a marked susceptibility to the disease. Harvest King, Fultz, Winter Fife, and Fulcaster were slightly injured; while **Red Wave, Red May and Turkey Red**, in these trials, as indicated in the table presented, were completely immune. The control of take-all lies in the selection of seed wheat from the varieties included in the table of recommended varieties.

As with flag smut, precautionary measures are being taken to prevent the further spread of this disease. The threshed grain is being treated with a strong solution of formaldehyde; in most cases this work is done as the grain comes from the threshing machine.

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CONTROL OF CORN ROTS BY SEED
SELECTION

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Investigations conducted in Illinois during the past fifteen years have shown that corn is affected by several rot diseases of the root, stalk, and ear. These rots have been found to be one of the chief causes of thin stands; of large numbers of weak and stunted plants; of stalks that are leaning, down, and broken; of barrenness and nubbins; of chaffy, immature ears; and of reduced yields.

Those in close touch with the situation feel that these rots are cutting the yields of the corn in the state fully fifteen percent; and careful observations convince us that these diseases are increasing thruout the corn belt.

CONTROL

The best method that has been developed to date for the control of these rots is the selection of disease-free seed ears. This selection is no single operation that can be completed within a few days; it is the result of carefully following out several steps at the proper time. The first step that is necessary to secure the best results in controlling these corn troubles is to select mature ears in the field from *healthy stalks growing in disease-free hills*.

SELECT BEST NORMALLY MATURED EARS FROM NORMAL STALKS

Fully matured ears, with sound shanks, from upright, sturdy stalks have shown, on the average, greater vigor and considerably more resistance to these diseases than similar appearing ears from stalks either slightly or badly diseased. Moreover, ears from leaning and broken stalks, and ears with slightly rotted shanks from erect stalks, are likely to be diseased. *Wilted and prematurely dead stalks commonly bear diseased ears*. Such stalks are frequently mistaken for early maturing stalks by those not suspecting their diseased condition.

Many apparently desirable seed ears droop because of weak, rotten, or broken shanks. Often such ears are diseased. Ears from stalks